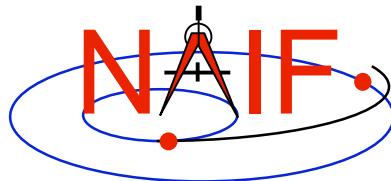


Navigation and Ancillary Information Facility

Time Conversion and Time Formats

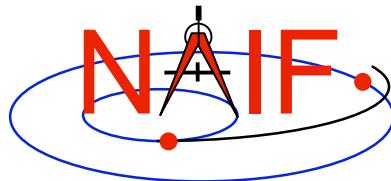
January 2009



Topics

Navigation and Ancillary Information Facility

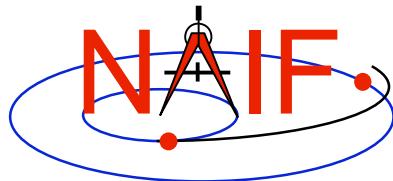
- **Time Systems and Kernels**
- **Converting Time Strings**
 - Calendar, Day-of-Year (DOY) and Julian Date strings to Ephemeris Time
 - Spacecraft Clock string to Ephemeris Time
 - Spacecraft Clock string to Encoded Spacecraft Clock (aka “Ticks”)
- **Converting Numeric Times - 1**
 - Ephemeris Time to Calendar, DOY and Julian Date strings
- **Use of Format Picture**
- **Converting Numeric Times - 2**
 - Ephemeris Time to Spacecraft Clock String
 - Encoded Spacecraft Clock to Spacecraft Clock String
 - Ephemeris Time to Local Solar Time String
- **Conversions Between Uniform Time Systems**
- **Customizing the Time System**
- **Pictorial Layout of the Time System**



Time Systems and Kernels

Navigation and Ancillary Information Facility

- **Three time systems are commonly used in SPICE for inputs and outputs in SPICE application programs:**
 - Coordinated Universal Time (UTC)
 - Spacecraft Clock (SCLK)
 - Ephemeris Time (ET, also referred to as Barycentric Dynamical Time, TDB)
- **Two time systems are commonly used in SPICE for kernel data look-ups or for computations**
 - Ephemeris Time (ET, TDB)
 - » Used in SPK, frames, PCK
 - » Used in high-level geometry interfaces
 - Encoded Spacecraft Clock (Ticks)
 - » Used in the intermediate level CK interfaces
- **The SPICE Leapseconds Kernel and Spacecraft Clock Kernel capture the relationships between**
 - UTC and ET (Leapseconds Kernel)
 - UTC or ET and SCLK (SCLK Kernel)
 - Caution: the long-term future relationships between these systems cannot be accurately predicted



Converting Time Strings

Navigation and Ancillary Information Facility

Examples for FORTRAN, C, IDL and MATLAB are shown on this page only.
Examples on subsequent pages are shown only in FORTRAN.

- **UTC, TDB, or TDT (TT) String to Ephemeris Time**

- **STR2ET (*string*, *ET*)**
- **str2et_c (*string*, &*et*)**
- **cspice_str2et, *string*, *et***
- ***et* = cspice_str2et (*string*)**

Converts any string in a format recognized by SPICE, excepting SCLK

Requires Leapseconds Kernel (LSK)

- **Spacecraft Clock String to Ephemeris Time**

- **SCS2E (*scid*, *string*, *ET*)**
- **scs2e_c (*scid*, *string*, &*et*)**
- **cspice_scs2e, *scid*, *string*, *et***
- ***et* = cspice_scs2e (*scid*, *string*)**

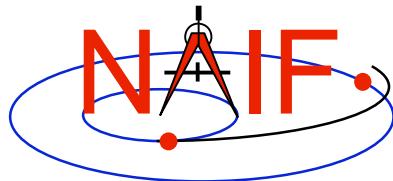
Requires Spacecraft Clock Kernel (SCLK)

Normally requires Leapseconds Kernel (LSK) as well, to handle a very small (~2 msec.) difference between TDB and TT

- **Spacecraft Clock String to Encoded Spacecraft Clock (used in the mid-level interfaces of the C-kernel system)**

- **SCENCD (*scid*, *string*, *SCLKDP*)**
- **scencd_c (*scid*, *string*, &*sclkdp*)**
- **cspice_scencd, *scid*, *string*, *sclkdp***
- ***sclkdp* = cspice_scencd (*scid*, *string*)**

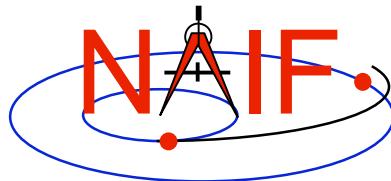
Requires Spacecraft Clock Kernel (SCLK)



Converting Numeric Times - 1

Navigation and Ancillary Information Facility

- Ephemeris Time to Calendar, DOY or Julian Date String
 - TIMOUT (*et*, *fmtpic*, STRING)
 - » The input *fmtpic* is a specification giving the user great flexibility in setting the appearance of the output time string, and the time system used (UTC, TDB, TDT).
 - YYYY Mon DD, HR:MN:SC.### ::UTC
 - 1999 Jan 12, 23:28:28.289
 - YYYY Mon DD, AP:MN:SC.### ampm ::UTC-8 (PST)
 - 1999 Jan 12, 03:28:28.289 p.m. (PST)
 - See the header for the TIMOUT module
 - The module TPICTR may be useful in constructing a format picture specification from a sample string
 - » Requires Leapseconds Kernel
 - ET2UTC (*et*, *format*, *prec*, UTCSTR)
 - » The *format* input specifies calendar, DOY, or Julian Date format for *UTCSTR*
 - » Requires Leapseconds Kernel
 - » Note: TIMOUT is a more capable routine
 - ETCAL (*et*, STRING)
 - » *STRING*, fixed format ephemeris calendar time string
 - » No Leapseconds Kernel is required.

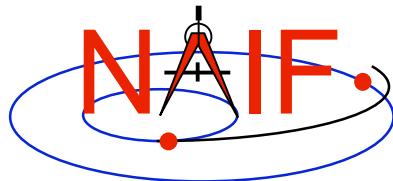


Use of Format Picture

Navigation and Ancillary Information Facility

Example Time Strings and the Corresponding Format Pictures

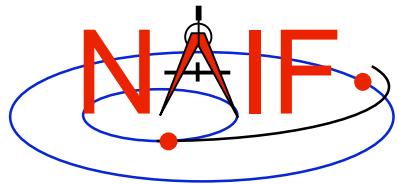
Time String	Format Picture Used (<i>fmpic</i>)
1999-283T12:28:29 (UTC)	YYYY-DOYTHR:MN:SC (UTC)
1999-283T12:29:33 (TDB)	YYYY-DOYTHR:MN:SC (TDB) ::TDB
Wed Nov 03, 19:29:05 1999	Wkd Mon DD, HR:MN:SC YYYY
465 B.C. Jan 12 03:15:23 p.m.	YYYY ERA Mon DD AP:MN:SC ampm
1987-11-03T04:29:58	YYYY-MM-DDTHR:MN:SC
04:28:55 A.M. June 12, 1982	AP:MN:SC AMPM Month DD, YYYY
Thursday November 04, 1999	Weekday Month DD, YYYY
DEC 31, 15:59:60.12 1998 (PST)	MON DD, HR:MN:SC YYYY (PST) ::UTC-8
2450297.1994 JDUTC	JULIAND.#### JDUTC



Converting Numeric Times - 2

Navigation and Ancillary Information Facility

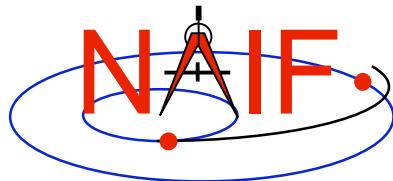
- Ephemeris Time to Spacecraft Clock String
 - SCE2S (*scid*, *et*, **SCLKCH**)
 - » Requires both LSK and SCLK
- Encoded Spacecraft Clock to Spacecraft Clock String
 - SCDECD (*scid*, *sclkdp*, **SCLKCH**)
 - » Requires SCLK
 - » SCLK string examples:
 - 1/1487147147.203 (Cassini, MGS)
 - 1/05812:00:001 (Voyager 1 and 2)
 - When literal clock strings are used as arguments in modules they must be contained in quotes:
 - Single quotes for Fortran, IDL, Matlab
 - Double quotes for C
- Ephemeris Time to Local Solar Time String
 - ET2LST(*et*, *body*, *long*, *type*, **HR**, **MN**, **SC**, **TIME**, **AMPM**)
 - » Requires SPK, PCK



Conversion Between Uniform Time Systems

Navigation and Ancillary Information Facility

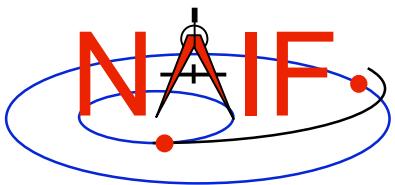
- Conversion between numeric representations of TAI, TDB(ET), TDT, JDTDB(JED), JDTDT
 - Return value = UNITIM (*epoch, insys, outsys*)



Customizing the Time System

Navigation and Ancillary Information Facility

- **Defaults**
 - Two digit year (a bad idea but supported): 1969-2068
 - Time System: UTC
 - Calendar: Gregorian
- **Adjustments**
 - The one hundred year interval to which two digit years belong may be set. For example 1980-2079
 - Time Systems: UTC, TDB, TT (Terrestrial Time)
 - Calendar: Gregorian, Julian, or Mixed.
- See the **TIMDEF module header** and ***Time Required Reading*** (`time.req`) for details



Principle Time System Interfaces

Navigation and Ancillary Information Facility

